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# Ion acceleration from ultra-thin foil targets using a PW-class laser with optimized temporal pulse profile

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Laser-driven ion acceleration promises to provide a compact solution for demanding applications like radiobiology experiments. For that, controlling particle beam parameters particularly in experiments with high energy Petawatt class ultra-short pulse systems with high repetition rate is a mandatory, yet challenging task. The performance of the plasma acceleration is strongly dependent on the complex laser target interaction which in turn is determined by the temporal laser intensity profile and spatio-temporal couplings on a large dynamic range. Plasma mirror setups have proven to significantly improve the temporal contrast by reducing pre-pulse intensity and steepening the rising edge of the main laser pulse, enabling the investigation of laser proton acceleration using ultra-thin and near critical density targets. Here we present benchmark experiments using the DRACO Petawatt laser at HZDR irradiating ultra-thin foil targets. A combination of particle and plasma diagnostics for ions and electrons as well as reflected and transmitted light revealed clear indications of acceleration in the relativistic transparency regime. The experiments were complemented by a suite of different laser pulse diagnostics, including self-referenced spectral interferometry with extended time excursion for single shot contrast analysis to characterize the laser pulse properties at the high power focus as realistic as possible.

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